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aerological work has been extended so that it is now carried on daily, including Sundays. Another innovation at Mount Weather is that of obtaining wind velocity aloft. The series of nine soundings of the free air made in two days is probably unprecedented in the annals of meteorology. This occurred on September 12 and 13 last, when from 6:37 in the morning of the first day to 1:06 in the afternoon of the next day the nine kite flights were made one after another, without a pause between them. During the last of these flights a west-north-west wind with a velocity of 69 miles per hour was successfully navigated by a kite at a height of 10,177 feet above sea level.

THE "spectre of the Brocken" is a phenomenon usually observed only from mountain summits. But for two hours on the night of August 6 it was observed by the writer from the top of the Blue Hill Observatory tower, the height being about 700 feet above sea level. Fog, which had been brought in from Boston Harbor by a light easterly wind, arrived at Blue Hill shortly before eight o'clock. Its upper surface, which was very distinct, was about at the level of the upper windows of the tower. The moon, about three-quarters full, was well above the horizon, and a few scattered cirrus streamers were the only high clouds visible. From the top of the ladder on the anemometer poles the surface of the fog stratum had the appearance of a wavy sheet of water. Directly opposite to the moon the observer could see, at an estimated distance of 75 feet, a dark image of himself enlarged about three times his natural size. The image was surrounded by a white light which faded away at its edges, leaving a dark space between it and a broad colorless circle, sometimes called "Ulloa circle" or "white rainbow." The circle was complete and appeared to have a radius of about 22°. When the observer moved the whole apparition moved likewise, proving it to be an entirely subjective phenomenon. It disappeared later when the fog deepened, rendering the moon invisible.

ANDREW H. PALMER

BLUE HILL OBSERVATORY,
November 1, 1911

SPECIAL ARTICLES

THE LIFE HISTORY OF A PARASITIC NEMATODE— HABRONEMA MUSCÆ

FIFTY years ago, from Bombay, India, the late H. J. Carter¹ reported the discovery of nematodes parasitic in the house fly, giving them the name of *Filaria muscæ*, and suggesting that their investigation might throw light on the life history of the guinea-worm. In the same year Diesing² transferred Carter's species to the genus *Habronema*, making it the type. Carter's description and figures, though not accurate in all respects, particularly in the interpretation placed on certain details of structure, are sufficient for the recognition of the species. Subsequently to Carter, several writers have mentioned the presence of nematodes in the house fly, in some cases identifying them with Carter's species, in other cases being apparently unaware that the species had ever been described or named. Leidy³ noted the occurrence of *Habronema muscæ* in about 20 per cent. of flies examined at Philadelphia. Further than occasional records of the occurrence of *Habronema muscæ* in flies, practically nothing up to the present time has been added to Carter's account of the worm, though it has long since become known that this parasite has nothing to do with the guinea-worm.

In the summer of 1910, the present writer found *Habronema muscæ* fairly common in house flies caught at Washington, D. C. The fact that this nematode occurred in the larval stage in flies suggested two alternative hypotheses, first, that the adult was a free living form, second, that the adult occurred parasitic in some host other than the fly. No evidence favoring the first hypothesis was obtained, as the nematodes from flies when placed in various media such as water, damp

¹ *Ann. and Mag. Nat. Hist., Lond.*, 3 s. (37), v. 7, January, 1861, pp. 29-33, pl. 1A, Figs. 1-4.

² *Sitzungsb. d. k. Akad. d. Wissensch., Wien, Math.-naturw. Cl.*, v. 43, 1 Abt. (4), pp. 273-274, 1861.

³ *Proc. Acad. Nat. Sc. Phila.* [v. 26, 3 s., v. 4] (2), April-September, 1874, pp. 139-140.

earth, horse manure, etc., invariably died without showing any indication of further development.

Further observations on *Habronema muscæ* were made during the summer of 1911, when it was found commonly present in house flies in Colorado and Nebraska. A series of stages in the development of the parasite was obtained by examination of various stages of the fly from larva to imago, and it became evident that the fly acquires its infection during its larval stage. This suggested the hypothesis that *Habronema muscæ* is the larval stage of a nematode parasitic during its adult stage in the horse, inasmuch as horse manure is a favorite breeding place of the house fly. The structure of the esophagus of *Habronema muscæ* suggested the further hypothesis that this parasite belonged either to *Spiroptera megastoma* or to *S. microstoma*, nematodes which occur in the stomach of the horse.

Ordinarily the testing of the hypothesis that *Habronema muscæ* is the larval stage of a horse parasite would require properly controlled feeding experiments, but, in September of the present year, the problem of the identity of the parasite was solved in another way. The stomachs of two horses were examined shortly after death. In one of them, a few adult nematodes were found which, from their naked eye appearance, closely resembled *Spiroptera microstoma*. In the other, a large number of the same species of adult worms was found, and in addition numerous smaller nematodes of various sizes. Microscopical examination of the worms collected from these horses revealed the presence of a complete series of stages in the development and growth of a single species of nematode from larva to adult, only the one species being represented, except that a few individuals of a species of *Trichostrongylus* were also present. The smallest forms corresponded perfectly to the nematodes found in adult flies, and the correctness of the hypothesis that *Habronema muscæ* is the larval stage of a nematode parasitic during its adult stage in the horse, was thus confirmed. The adults of *Habronema muscæ*, though very similar to, proved to be

different from, *Spiroptera microstoma*, most noticeably in the structural details of the head and pharynx, vagina of the female and bursa and spicules of the male. The spicules alone present sufficient evidence of a specific difference in the two forms, as will appear from the following measurements:

In *Habronema muscæ* the left spicule measures about 2.5 mm. in length and about 5 μ in diameter near its middle, the right spicule about 500 μ in length by about 10 μ in diameter near its middle. In *Spiroptera microstoma*, or, giving this species its correct generic designation, in *Habronema microstoma* the left spicule measures about 800 μ in length by about 15 μ in diameter near its middle, the right spicule about 350 μ in length by about 20 μ in diameter near its middle.

The life history of *Habronema muscæ*, as determined by the results of the investigations which have been briefly sketched in the present paper, may be summed up as follows:

A horse infested with the adult worms excretes their embryos in its feces. These embryos enter the bodies of fly larvæ developing in the feces from eggs deposited by house flies. During the development of the fly larvæ and pupæ, the worms with which they have become infested also undergo a process of growth and development, reaching their final larval stage at about the time the flies emerge from the pupal state. Further development of the worms waits upon the swallowing of the infested flies by a horse, in which event the life cycle becomes completed by the growth of the worms to maturity.

Of interest to entomologists and sanitarians is the fact that *Habronema muscæ* affords a means of determining with some degree of accuracy what proportion of the flies occurring in a given locality find their breeding place in horse manure, to this extent, that if examination of a considerable number of flies shows that a certain per cent. are infected, it may be safely assumed that at least that percentage of the flies in the locality have developed in horse manure. A percentage obtained in this way would of course probably be considerably smaller than the actual percentage, as

it is unlikely that all horses in the locality would be infested and as some flies even though developing in manure from an infested horse would probably escape infection.

A more comprehensive discussion of *Habronema*, illustrated with figures, will be published at a later date, probably as a bulletin of the Bureau of Animal Industry.

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SOCIETIES AND ACADEMIES

THE AMERICAN MATHEMATICAL SOCIETY

THE one hundred and fifty-fifth regular meeting of the society was held at Columbia University on Saturday, October 28. The attendance at the two sessions was about forty, including thirty-five members. President H. B. Fine occupied the chair. The council announced the election of the following persons to membership in the society: Professor T. B. Ashcraft, Colby College; Professor Clara L. Bacon, Goucher College; Professor J. M. Davis, State University of Kentucky; Professor W. C. Eells, Whitworth College; Dr. J. L. Jones, Yale University; Professor F. C. Kent, University of Oklahoma; Professor L. C. Plant, University of Montana; Mr. R. E. Powers, Denver, Colo.; Mr. T. M. Simpson, University of Wisconsin; Professor Evan Thomas, University of Vermont; Professor H. C. Wolff, University of Wisconsin; Mr. W. A. Zehring, Purdue University. Nine applications for membership were received.

A list of nominations of officers and other members of the council, to be placed on the ballot for the annual election, was adopted. Provision was made for committees to audit the treasurer's accounts and to make arrangements for the summer meeting to be held at the University of Pennsylvania in 1912. The invitation of the University of Wisconsin to hold the summer meeting and colloquium at that university in 1913 was accepted. It was decided to change the form of the *Annual Register* of the society by omitting all mention under the personal entries of membership in other organizations. A committee was appointed to consider and report to the council a plan for placing the business of the society on a permanent basis.

The following papers were read at this meeting:

A. R. Schweitzer: "On a functional equation."

E. V. Huntington: "A new approach to the theory of relativity."

L. P. Siceloff: "Simple groups from order 2,001 to order 3,640."

H. H. Mitchell: "Determination of the quaternary linear groups by geometrical methods."

G. A. Bliss: "A new proof of the existence theorem for implicit functions."

R. E. Powers: "The tenth perfect number."

E. W. Brown: "On the summation of a certain triply infinite series."

L. L. Dines: "On the highest common factor of a system of polynomials."

R. D. Carmichael: "A generalization of Cauchy's functional equation."

R. D. Carmichael: "Fundamental properties of a reduced residue system mod n ."

R. D. Carmichael: "On composite numbers P which satisfy the Fermat congruence $a^{P-1} \equiv 1 \pmod{P}$."

Edward Kasner: "Differential invariants of infinite order."

B. H. Camp: "Series of Laplace's functions."

N. J. Lennes: "A new proof that a Jordan curve separates a plane."

The San Francisco Section of the society also met on October 28, at the University of California. The Southwestern Section holds its fifth annual meeting at Washington University on Saturday, December 2. The annual meeting of the society for the election of officers will be held at Columbia University on December 27-28. The Chicago Section will also meet in the Christmas holidays.

F. N. COLE,

Secretary

THE AMERICAN PHILOSOPHICAL SOCIETY

Factors affecting Changes in Body Weight:

FRANCIS G. BENEDICT.

The normal human body is continually undergoing changes in weight, gradually losing weight between meals, and increasing it when food is taken. Very great losses incidental to excessive muscular exercise are chiefly due to variations in the water content of the body. By means of experiments with the respiration calorimeter, it has been shown that a change from a diet with a preponderance of carbohydrates to one with a preponderance of fat may cause a loss in weight amounting to two pounds per diem for three days. Experiments made with diabetics also show large changes, chiefly due to the retention or the loss of water. The gains or losses of body material, chiefly fat, are especially emphasized.